

Basis for the Development of Nutrient Criteria for Lakes and Reservoirs and Guidance on Monitoring, Assessment and Permitting DRAFT January 2006

1.0 BACKGROUND ON THE AMENDMENTS

This rulemaking is needed to establish the appropriate nutrient criteria for lakes and reservoirs in the Commonwealth of Virginia because:

- 1) The U.S. Environmental Protection Agency (EPA) has published ecoregion water body specific nutrient related criteria and stated its intent in a National Nutrient Strategy (1998) to promulgate these default nutrient criteria for a state if the state does not adopt nutrient criteria by December 31, 2004 or submit a nutrient development plan with timelines for adoption of this criteria that are accepted by EPA. As discussed below, Virginia decided to take the latter approach.
- 2) These water quality standards will be used in setting Virginia Pollutant Discharge Elimination System Permit limits and for evaluating the waters of the Commonwealth for inclusion in the Clean Water Act 305(b) report and on the 303(d) list, and
- 3) Waters not meeting standards will require development of a Total Maximum Daily Load (TMDL) under section 303(d) of the Clean Water Act. Adoption of water body type specific criteria and uses is necessary to define the most accurate water quality goals for clean up or TMDL development and to protect the appropriate aquatic life and recreational uses of lakes and reservoirs.

Since Virginia intended to develop state specific criteria rather than adopt the EPA published national nutrient criteria, the state submitted to EPA a nutrient criteria development plan for Virginia that EPA has accepted in June, 2004. EPA uses the plan to track the State's progress in nutrient criteria development. If the Commonwealth keeps to the schedule contained in the Plan, EPA is not expected to promulgate nutrient criteria for the State.

Virginia is committed through its Nutrient Criteria Development Plan to adopt new and revised water quality standards for estuaries, lakes and reservoirs, and rivers and streams. The Department is using a two step process - technical development of nutrient criteria and administrative adoption of the criteria - for each water body type. Prioritization of waters for criteria development and adoption is based on availability of data to proceed with a rulemaking. This sequential approach to the development and regulatory adoption of nutrient criteria was completed in 2005 for estuaries; the current rulemaking is for lakes and reservoirs and in 2008 a separate rulemaking will be initiated for rivers and streams.

Since mid-2003 an Academic Advisory Committee (AAC) on Freshwater Nutrient Criteria - that was formed by the Virginia Water Resources Research Center under contract to DEQ - has been providing advice to the Department on nutrient criteria development for lakes and reservoirs. The documents produced by the AAC and used by the Department in developing these amendments can be found on the Department's web site at: <http://www.deq.virginia.gov/wqs/rule.html#NUT2>.

The Department utilized the participatory approach by forming an ad hoc advisory committee; four public noticed meetings (May 4, June 8, July 7, and August 9, 2005) of this committee were held in Richmond. A summary of each of these meetings is provided at the same web address (<http://www.deq.virginia.gov/wqs/rule.html#NUT2>) as the AAC documents referenced earlier. The AAC also participated in the advisory committee meetings and prepared additional reports for agency evaluation to implement some of the modifications recommended by the committee.

2.0 SUMMARY OF THE AMENDMENTS

The table below summarizes substantive changes proposed to amend the state's Water Quality Standards regulation to add new numerical and narrative criteria to protect designated uses of man-made lakes and reservoirs as well as the two natural lakes in the state from the impacts of nutrients.

Special nutrient standards are proposed for the two natural lakes in Virginia – Mountain Lake and Lake Drummond -separate from man-made lakes and reservoirs.

Numeric chlorophyll a and total phosphorus criteria are proposed for the 116 man-made lakes and reservoirs that the Department has previously monitored or plans to monitor. The AAC recommended establishing nutrient criteria for man-made lakes and reservoirs using historical data for Virginia lakes, fishery type use classifications for lakes and reservoirs, and the EPA concept of ecoregion specific criteria. Department staff concurred with the AAC recommendations to base the nutrient criteria on protection of fishery and associated secondary contact recreational uses. We used the AAC classification of nutrient criteria by fishery type and nutrient ecoregion to develop the table in the proposed new section 187 of the regulation. We are recommending using chlorophyll a as the primary nutrient criterion because of its close tie to biological effects. Such a close relationship was not observed with total phosphorus. However, the Department's records indicate that 18% of these man-made lakes and reservoirs have a known recent history of algicide use. This is usually done in public water supply reservoirs to assist in treating the water for human consumption. Therefore, a total phosphorus criterion is also recommended when the application of algaecides is identified during the seven-month sampling period of April 1 through October 31. Additional reservoirs would be added to the regulation in the future as data are collected for those waters.

In section 5 of the regulation, which defines words and terms used in the water quality standards regulation, we have proposed the addition of five terms which are used in the text amendments.

The rulemaking also proposes clarifying that during times of thermal stratification, the existing dissolved oxygen criteria should only apply to the upper layer in the lake-like portion of man-made lakes and reservoirs covered by these nutrient criteria. The rationale for this is that lakes and reservoirs naturally have low oxygen levels in the bottom layer during times of stratification. Nutrient enrichment may contribute to even lower oxygen levels at these depths. However, those effects of nutrient enrichment would be controlled by the applicable nutrient criteria in proposed in section 9 VAC 25-260-187 of the regulation, so the low oxygen in the deeper portions of these reservoirs would only be due to natural conditions.

In addition, a statement is included to allow for site specific modifications to the criteria if the nutrient criteria specified for a man-made lake or reservoir do not provide for the attainment and maintenance of the water quality standards of downstream waters; this was proposed to address the phased development of nutrient criteria for lakes and reservoirs preceding those for rivers and streams.

This rulemaking effort also involved an evaluation of the applicability of Virginia's current regulatory program (Nutrient Enriched Waters) for controlling nutrients in surface waters, including lakes and reservoirs. The concept of Nutrient Enriched Waters was not incorporated into the final approach selected by the State, so a plan was developed to transition from the existing regulatory Nutrient Enriched Waters listings to the new regulatory approach by sequentially deleting currently designated Nutrient Enriched Waters as the Commonwealth adopts nutrient criteria for those waters. Therefore, this rulemaking proposes the repeal of the following nutrient enriched waters designations in 9 VAC 25-260-350, Designation of Nutrient Enriched Waters: Smith Mountain Lake, Lake Chesdin, South Fork Rivanna Reservoir, and Claytor Lake.

Current section number	Proposed new section number, if applicable	Current requirement	Proposed change and rationale
9 VAC 25-260-5		Definitions	Added definitions for new terms used in the proposed amendments: ‘algicide’, ‘epilimnion’, ‘lacustrine’, ‘man-made lake or reservoir’, and ‘natural lake.’
9 VAC 25-260-50		Lists dissolved oxygen, pH and temperature criteria for Class I - VII waters.	Added a fourth footnote to the table in the dissolved oxygen column to recognize that for a thermally stratified man-made lake or reservoir listed in 9 VAC 25-260-187, the dissolved oxygen criteria only apply to the epilimnion in the lacustrine portion of the water body.
none	9 VAC 25-260-187	None since this is a new section.	Lists 116 man-made lakes and reservoirs that the Department has previously monitored or plans to monitor and the waterbody specific chlorophyll <i>a</i> and total phosphorus criteria to protect aquatic life and recreational designated uses in these waters from the impacts of nutrients. Allows for site specific modifications to the criteria if the nutrient criteria specified for a man-made lake or reservoir do not provide for the attainment and maintenance of the water quality standards of downstream waters.
9 VAC 25-260-310		Contains site-specific and effluent criteria for various water bodies.	Adds new site-specific numerical nutrient criteria for the two natural lakes in Virginia: Mountain Lake and Lake Drummond.
9 VAC 25-260-350		Four lakes (Smith Mountain Lake, Lake Chesdin, South Fork Rivanna Reservoir, and Claytor Lake) are listed as "nutrient enriched waters." Waters listed in this section are subject to phosphorus limits under the Nutrient Enriched Waters Policy (9 VAC 25-40 et seq.)	These four lakes are repealed from the list of nutrient enriched waters since the new method of controlling nutrients in these and other man-made lakes and reservoirs will be from implementation of the criteria set forth in 9 VAC 25-260-187.
9 VAC 25-260-415		James River Basin, Appomattox references the “nutrient enriched waters” status of Lake Chesdin as NEW -2.	Deletes reference to NEW -2 because is being repealed in 9 VAC 25-260-350.
9 VAC 25-260-420		James River Basin, Middle references the “nutrient enriched waters” status of South Fork Rivanna Reservoir as NEW -3.	Deletes reference to NEW -3 because is being repealed in 9 VAC 25-260-350.
9 VAC 25-260-450		Roanoke River Basin Roanoke subbasin references the “nutrient enriched waters” status of Smith Mountain Lake as NEW -1.	Deletes reference to NEW -1 because is being repealed in 9 VAC 25-260-350.
9 VAC		Chowan and Dismal Swamp	Adds to special standards column the new site-

25-260-480		Basin Albemarle Subbasin section table.	specific criteria numerical nutrient criteria “dd” for Lake Drummond.
9 VAC 25-260-540		New River Basin section table references the “nutrient enriched waters” status of Claytor Lake as NEW -4.	Adds to special standards column the new site-specific criteria numerical nutrient criteria “cc” for Mountain Lake and deletes reference to NEW -4 because it is being repealed in 9 VAC 25-260-350.

3.0 BASIS FOR DEVELOPMENT OF THE REGULATION

3.1 Rationale for Moving Several Definitions (9 VAC 25-260-5) Out of the Final Proposal into this Support Document

The current revised version of the proposal no longer uses some of these terms so they were deleted from the proposal. One new term – algicide- was introduced in section 9 VAC 25-260-187, so there is now in the current version of the draft amendments a definition for that word. When section 9 VAC 25-260-187 was revised to list by name the waters to which the criteria applied, staff felt that requiring the reader to refer to two tables to determine the appropriate concentration could lead to errors. Therefore, the appropriate values for chlorophyll *a* and total phosphorus are now proposed for listing next to the water body name, and the general table “A” that listed the Academic Advisory Committee recommended criteria values by fishery type and ecoregion was moved to this support document. The associated terms that were previously in the definitions section were also moved to this support document: coldwater fishery, cool water fishery, ecoregion, fertilized fishery, and warm water fishery. The definition of man-made lake and reservoirs was modified to refer specifically to the term “constructed impoundments” found in the Academic Advisory Committee reports, so the definition for residence time was no longer needed.

3.2 Rationale for Establishing DO Criteria in the Epilimnion Only in 9 VAC 25-260-50

At the request of DEQ, the AAC undertook a literature review by Little, Singleton and Bryant entitled “AAC Lake Oxygen Report – Final.”

The findings and recommendations of this report were summarized by staff at the June 8 advisory committee meeting:

Staff summarized the AAC Dissolved Oxygen Report: There is no specific EPA guidance on application of existing dissolved oxygen (DO) criteria to lakes and reservoirs. Therefore, states can interpret and apply the DO criteria for stratified water bodies as appropriate. VA DEQ applies existing DO criteria to the entire water column of lakes and reservoirs during stratified and unstratified conditions, resulting in a number of impoundments being classified impaired because of DO criteria violations.

The AAC report recommended that VA DEQ:

- *Establish DO criteria for lakes and reservoirs based on designated uses*
- *Develop separate criteria for the epilimnion and hypolimnion based on designated uses to avoid unnecessarily stringent single DO criterion*
- *Develop separate DO criteria for natural lakes and constructed impoundments*
- *Continue current TMDL methodology until develop lake and reservoir criteria and after development of revised DO criteria, reservoirs that were previously classified as impaired may be reclassified as waters supporting one or more designated uses.*

- *Apply a single DO criterion that supports the water body's designated uses to all depths when the water column is completely mixed*
- *Ensure that the DO criteria for stratified reservoirs allows for at least one layer in the reservoir where temperature, DO & pH requirements are being met to support designated uses.*
- *Consider not requiring hypolimnetic DO criteria for a given impoundment if the water utility can only withdraw water for treatment from the epilimnion.*

The report also stated that if all reservoirs in VA are designated for aquatic life and/or water supply use, the DO criteria to support these uses would more than likely be adequate to support swimming and other recreational uses and separate DO criteria for these uses would not be necessary.

Therefore, the advisory committee and DEQ staff developed the current proposal for stratified lakes. Restricting application of the dissolved oxygen criteria to the epilimnion during times of stratification is a new proposal reflecting the suggestions in the AAC report, but the portion of the footnote discussing applicability of the dissolved oxygen criteria to the entire water during times of destratification is unchanged from the current application of the criteria.

It is important to note that the application of the dissolved oxygen criteria to only the epilimnion during times of thermal stratification is limited to the man-made lakes and reservoirs listed under section 187 for protection by numerical nutrient criteria. The expectation is that the numerical criteria will protect these waters from the effects of nutrient enrichment, especially since the criteria are set at concentrations lower than what would exceed the 60 value in Carlson's Trophic State Index that is indicative of nutrient enrichment.

3.3 Sources for Lakes Listed in the Table in 9 VAC 25-260-187

The list of man made lakes and reservoirs was developed from three Virginia DEQ sources: the significant lake list for the agency 2002 targeted lake monitoring guidance, the revised for 2006 significant lakes list, both of which were based on publicly accessible public water supplies and/or lakes/reservoirs 100 acres or greater in size, and 59 lakes (an additional 4 - Byllesby, Nottoway Falls, Swift Creek Lake and Banister Lake - were excluded due to residence time < 5 days) monitored by VA DEQ between 1990 and 2003 that were included in the AAC analysis for nutrient criteria development if observations were present in at least 6 of the 7 sampling months (April – October) and 1 or more observations per month. Therefore, these are the lakes and reservoirs that VA DEQ has monitored previously, currently is monitoring or will be monitoring in the upcoming assessment cycle. DEQ anticipates that additional lakes and reservoirs will be added to the regulation during triennial review and citizen petitions as new reservoirs are constructed or monitoring data become available from outside groups or future agency monitoring.

Every triennial review, DEQ will add newly monitored lakes and reservoirs to the list in 187B. If there is a citizen petition to amend the water quality standards regulation to add their lake that they had been monitoring to the list in section 187B, that would be on its own separate regulatory time track per the Administrative Process Act and DEQ Public Participation Guidelines.

3.4 Rationale for Not Establishing Criteria for Total Nitrogen and Secchi Depth in Man-Made Lakes

On page 4 in the paragraph labeled "Demonstrate Where Criteria Not Needed" in the March 24, 2004 Virginia Development Plan for Nutrient Criteria that was accepted by EPA Region 3, the approach for demonstrating that total nitrogen criteria are not needed is explained:

***Demonstrate Where Criteria Not Needed.** The State also intends to direct some effort toward generating the data needed to support a decision to not adopt one or more of the criteria (such as total nitrogen in*

phosphorus limited lakes and other waters). This will be accomplished by the development from the state CEDS database TN/TP ratios for representative lakes, streams and rivers in each river basin as well as evaluation of several published reports on limiting nutrients in Virginia waters. The reports utilized will include – but not be limited to - USGS publications, bulletins from the Virginia Water Resources Research Center (Sherrard and Hoyle, 1977; Beaty and Parker, circa 1993), and algal growth potential bioassay data for selected lakes summarized in a 1982 report on EPA Clean Lakes Program funded monitoring and research in publicly accessible lakes and reservoirs in Virginia (SWCB, 1982). The Commonwealth will also evaluate existing monitoring data and consider as an option the establishment of criteria at ambient total nitrogen concentrations in freshwater rivers and streams if it can be demonstrated that these levels do not interfere with designated uses and do not contribute to an exceedence of a downstream criterion. The Commonwealth will start with criteria development in the estuary and work its way upstream so appropriate criteria will have already been established downstream.

The AAC recommended that nutrient criteria for man-made lakes and reservoirs should be expressed as water column chlorophyll *a* because chlorophyll *a* is an indicator of algal biomass, which can impair designated uses at excessive levels. The AAC recommended that criteria should be expressed as TP only if TP-chla relationships are predictable because TP-chla relationships are more variable in impoundments than in natural systems.

The AAC recommended that nitrogen criteria should not be established. The rationale for this was because some algae (including blue-greens) are nitrogen fixing, total phosphorus will have the most influence on algal levels. The potential is for nitrogen reductions, if applied independently of phosphorus, to stimulate blue-green algae, and affect use negatively.

In addition, VA DEQ conducted a literature search and found several publications that indicated that total phosphorus was the limiting nutrient for that particular man-made lake or reservoir, all of which are included in section 187:

Cawley, Jon C. 1999. A re-evaluation of Mountain Lake, Giles County, Virginia: Lake Origins, History and Environmental Systems. VA Tech Dissertation.

Johnson, David M. and Carolyn L. Thomas. 1999. Smith Mountain Lake Water Quality Monitoring Program. 1998 Report. Smith Mountain Lake Association.

State Water Control Board. Commonwealth of Virginia. 1982. Classification and Priority Listing of Virginia Lakes. EPA Grant Number S-003219-01-0. Richmond, Virginia. Appendix D. Algal Assay Results. Three (Lake Accotink, Lake Chesdin, and Rivanna Reservoir) of the five lakes are listed in section 187 and all three were phosphorus limited.

Although the AAC developed an aquatic life secchi depth criterion for lakes and reservoirs, it was not included in the proposal because of the following secchi disk related comments in the AAC January 2005 Report:

p. 5: Secchi depth failed to exhibit summer minima as expected, possibly due to the influence of non-algal turbidity caused by TSS.

p. 15: Sediments-related non-algal turbidity varies spatially within reservoirs. Suspended sediments delivered to impoundments lead to levels of non-algal turbidity that interfere with algal production found in Smith Mountain Lake and Claytor lakes.

3.5 Rationale for Calculating Chl *a* Numeric Values Using the Percentile Approach and the TP Numeric Values Using the Median of the Data Set, Including Evidence To Support the State's Conclusion that the Criteria are Protective of Aquatic Life and Fishery Recreation

The basis for this conclusion is documented in the AAC January 2005 and July addendum reports. Man-made lake and reservoir data for the time period 1990 -2003 were included in AAC analysis for nutrient criteria development if observations were present in at least 6 of the 7 sampling months (April – October) and 1 or more observations per month. Analyses were conducted using the EPA recommended approach of considering each lake to be a sampling unit.

The AAC recommended that in reservoirs, recreational fish population status can be an indicator of suitability for aquatic life. The rationale was that recreational fish species are generally the highest trophic level and most impoundments are used or managed for recreational fishing. The AAC recommended that recreational fish status can be assessed by obtaining Virginia Department of Game and Inland Fishery biologist ratings, considering fishery types. The rationale is that fish population data represent a number of impoundments, and are comparable, are not available and would be expensive to gather.

Dr. John Ney with the AAC used a literature review and analysis of nutrient data vs. “fishery status” ratings by the Virginia Division of Game and Inland Fisheries to determine candidate nutrient criteria that would be protective of aquatic life and suitability for recreational fisheries.

The VDGIF “Fishery Status” Ratings were:

- 1 = poor: biologists recommend anglers avoid.
- 2 = fair: biologists recommend anglers not expect fishing success.
- 3 = average: lake supports adequate fishery.
- 4 = good: biologists recommend for fishing.
- 5 = excellent: biologists highly recommend for fishing.

The results of this approach are summarized in the table below by ecoregion and fishery type which, as defined in the January AAC Report, include warm water, cool water (large multi-purpose lakes with top layer warm water fisheries and bottom layer cool water fisheries), managed or fertilized reservoirs and coldwater reservoirs (trout).

Candidate criteria to accommodate fishery recreation and protect aquatic life, as recommended by AAC January 2005 report.^a

Fishery Type	Warm-water	Cool-water	Cold-water (trout)	Managed / Fertilized	Warm-water	Cool-water	Cold-water (trout)	Managed / Fertilized
Eco-region	----- chl-a (µg/L)-----				----- TP (µg/L)-----			
11	25	10	4		40	20	10	
9	25	10		60	40	30		40
14	25	10			40	20		

^aTP and Chl-a are median values representative of the April – October period.

In the January 2005 AAC Report, both chlorophyll *a* and total phosphorus criteria were calculated using the median of the data set. However, the AAC re-evaluated the calculation of the chlorophyll *a* criteria for the 90th percentile.

In an “AAC Addendum to January 2005 Report” Dr. Zipper summarized his investigation after the first advisory committee meeting in May 2005 of the potential for alternate expressions of chlorophyll “a” criteria that are reflective of the conditions that can occur during high algal population episodes. The advisory committee had asked him to explore this because extreme (not median or average) conditions cause impairments and the criteria should reflect those conditions. He determined that the 90th percentile

was a more appropriate metric than the maximum value for criteria expression or chlorophyll *a* because the maximum value is biased by the number of observations while no bias by number of observations is apparent with the 90th percentile. He considered three methods (regression, graphic, and scientific literature) for translating the criteria from median values to the alternative expression and decided to rely on the graphic approach. The results of this approach are summarized in the table below by ecoregion and fishery type which, as defined in the January AAC Report, include warm water, cool water (large multi-purpose lakes with top layer warm water fisheries and bottom layer cool water fisheries), managed or fertilized reservoirs and coldwater reservoirs (trout).

Potential candidate criteria for chl-*a* 90 to protect fishery recreation and aquatic life expressed as 90th percentiles of water-monitoring observations collected monthly and evenly distributed over the April – October period.^a

Fishery Type	Warm-water	Cool water	Coldwater (trout)	Managed / Fertilized
Eco-region	----- chl-a (µg/L) -----			
11	35	25	10	
9	35	25		60
14	60	25		

Candidate criteria to accommodate fishery recreation and protect aquatic life, as recommended by AAC January 2005 report and July 2005 Addendum One to the January Report

Fishery Type	Warm-water	Cool-water	Cold-water (trout)	Managed / Fertilized	Warm-water	Cool-water	Cold-water (trout)	Managed / Fertilized
Eco-region	----- chl-a (µg/L) ^a -----				----- TP (µg/L) ^b -----			
11	35	25	10		40	20	10	
9	35	25		60	40	30		40
14	60	25			40	20		

^a Chl-*a* are 90th percentile values representative of the April – October period.

^b TP are the median values representative of the April – October period.

3.6 Basis for Fishery Type Definitions and Assignments by Nutrient Ecoregion

Pages 10 -11 and 16 -33 of the AAC January 2005 Report discuss the use of fishery data by ecoregion and fishery type for setting criteria for chlorophyll *a* and total phosphorus. For those impoundments which were not included in the AAC original list of 59 that were assigned fishery type status by the VDGIF, DEQ staff worked with the VDGIF representative to the advisory committee to assign fishery type. The following definitions of fishery type were followed in making these assignments.

“Coldwater fishery” means a fishery in a man-made lake or reservoir for the year-round support of brook, brown, and rainbow trout.

“Coolwater fishery” means a fishery in a man-made lake or reservoir for the year-round support of game fish species such as striped bass, hybrid striped bass, or walleye.

“Fertilized fishery” means man-made lakes or reservoirs managed by the Virginia Department of Game and Inland Fisheries with fertilizers applied as a management input for centrarchid species (for example, sunfish, crappie, and black bass) or catfish species. These lakes are generally quite small, and fish production is the primary use.

“Warmwater fishery” means a fishery in a man-made lake or reservoir for the year-round support of warmwater fish such as largemouth and smallmouth bass, sunfish and catfish, and not explicitly classified as a coldwater, coolwater or fertilized fishery.

Man-made Lake or Reservoir Name	Location	Fishery Type	Ecoregion
Able Lake	Stafford County	Warmwater	9
Airfield Pond	Sussex County	Warmwater	9
Amelia Lake	Amelia County	Warmwater	9
Aquia Reservoir (Smith Lake)	Stafford County	Warmwater	11
Bark Camp Lake (Corder Bottom Lake, Lee/Scott/Wise Lake)	Scott County	Warmwater	11
Beaver Creek Reservoir	Albemarle County	Warmwater	9
Beaverdam Creek Reservoir (Beaverdam Reservoir)	Bedford County	Warmwater	11
Beaverdam Reservoir	Loudoun County	Warmwater	9
Bedford Reservoir (Stony Creek Reservoir)	Bedford County	Warmwater	11
Big Cherry Lake	Wise County	Warmwater	11
Breckenridge Reservoir	Prince William County	Warmwater	9
Briery Creek Lake	Prince Edward County	Warmwater	9
Brunswick Lake (County Pond)	Brunswick County	Warmwater	9
Burke Lake	Fairfax County	Warmwater	9
Carvin Cove Reservoir	Botetourt County	Warmwater	11
Cherrystone Reservoir	Pittsylvania County	Warmwater	9
Chickahominy Lake	Charles City County	Warmwater	9
Claytor Lake	Pulaski County	Coolwater	11
Clifton Forge Reservoir (Smith Creek Reservoir)	Alleghany County	Warmwater	11
Coles Run Reservoir	Augusta County	Coldwater	11
Curtis Lake	Stafford County	Fertilized	9
Diascund Creek Reservoir	New Kent County	Warmwater	9
Douthat Lake	Bath County	Coolwater	11
Elkhorn Lake	Augusta County	Coldwater	11
Emporia Lake (Meherrin Reservoir)	Greensville County	Warmwater	9
Fairystone Lake	Henry County	Warmwater	11
Falling Creek Reservoir	Chesterfield County	Warmwater	9
Fort Pickett Reservoir	Nottoway/Brunswick County	Warmwater	9
Gatewood Reservoir	Pulaski County	Warmwater	11
Georges Creek Reservoir	Pittsylvania County	Warmwater	9

Goose Creek Reservoir	Loudoun County	Warmwater	9
Graham Creek Reservoir	Amherst County	Warmwater	9
Great Creek Reservoir	Lawrenceville	Warmwater	9
Harrison Lake	Charles City County	Warmwater	9
Harwood Mills Reservoir	York County	Warmwater	14
Hidden Valley Lake	Washington County	Warmwater	11
Hogan Lake	Pulaski County	Warmwater	11
Holiday Lake	Appomattox County	Warmwater	9
Hungry Mother Lake	Smyth County	Warmwater	11
Hunting Run Reservoir	Spotsylvania County	Warmwater	9
J. W. Flannagan Reservoir	Dickenson County	Coolwater	11
Kerr Reservoir, Virginia portion (Buggs Island Lake)	Halifax County,	Coolwater	9
Keysville Reservoir	Charlotte County	Warmwater	9
Lake Albemarle	Albemarle County	Fertilized	9
Lake Anna	Louisa County	Coolwater	9
Lake Burnt Mills	Isle of Wight County	Warmwater	14
Lake Chesdin	Chesterfield County	Warmwater	9
Lake Cohoon	Suffolk City	Warmwater	14
Lake Conner	Halifax County	Warmwater	9
Lake Frederick	Frederick County	Warmwater	11
Lake Gaston, (Virginia portion)	Brunswick County	Coolwater	9
Lake Gordon	Mecklenburg County	Warmwater	9
Lake Keokee	Lee County	Warmwater	11
Lake Kilby	Suffolk City	Warmwater	14
Lake Lawson	Virginia Beach City	Warmwater	14
Lake Manassas	Prince William County	Warmwater	9
Lake Meade	Suffolk City	Warmwater	14
Lake Moomaw	Bath County,	Coldwater	11
Lake Nelson	Nelson County	Warmwater	9
Lake Nottoway ((Lee Lake, Nottoway Lake)	Nottoway County	Warmwater	9
Lake Pelham	Culpeper County	Warmwater	9
Lake Prince	Suffolk City	Warmwater	14
Lake Robertson	Rockbridge County	Warmwater	11
Lake Smith	Virginia Beach City	Warmwater	14
Lake Whitehurst *	Norfolk City	CoolwaterWarmwater*	14
Lake Wright	Norfolk City	Warmwater	14
Laurel Bed Lake	Russell County	Warmwater	11
Lee Hall Reservoir (Newport News Reservoir)	Newport News	Warmwater	14
Leesville Reservoir	Bedford County	Coolwater	9
Little Creek Reservoir	Virginia Beach City	Warmwater	14
Little Creek Reservoir	James City County	Coolwater	9
Little River Reservoir	Montgomery County	Warmwater	11
Lone Star Lake F (Crystal Lake)	Suffolk City	Warmwater	14

Lone Star Lake G (Crane Lake)	Suffolk City	Warmwater	14
Lone Star Lake I (Butler Lake)	Suffolk City	Warmwater	14
Lunga Reservoir	Prince William County	Warmwater	9
Lunenburg Beach Lake (Victoria Lake)	Town of Victoria	Warmwater	9
Martinsville Reservoir	Henry County	Warmwater	9
(Beaver Creek Reservoir)			
Mill Creek Reservoir	Amherst County	Warmwater	9
Modest Creek Reservoir	Town of Victoria	Warmwater	9
Motts Run Reservoir	Spotsylvania County	Coolwater	9
Mount Jackson Reservoir	Shenandoah County	Warmwater	11
Mountain Run Lake	Culpeper County	Warmwater	9
Ni Reservoir	Spotsylvania County	Warmwater	9
North Fork Pound Reservoir	Wise County	Warmwater	11
Northeast Creek Reservoir	Louisa County	Warmwater	9
Occoquan Reservoir	Fairfax County	Warmwater	9
Pedlar Lake	Amherst County	Warmwater	11
Philpott Reservoir	Henry County	Coolwater	9
Phelps Creek Reservoir (Brookneal Reservoir)	Campbell County	Warmwater	9
Ragged Mountain Reservoir	Albemarle County	Warmwater	9
Rivanna Reservoir (South Fork Rivanna Reservoir)	Albemarle County	Warmwater	9
Roaring Fork	Pittsylvania County	Warmwater	9
Rural Retreat Lake	Wythe County	Warmwater	11
Sandy River Reservoir	Prince Edward County	Warmwater	9
Shenandoah Lake	Rockingham County	Warmwater	11
Silver Lake	Rockingham County	Warmwater	11
Smith Mountain Lake	Bedford County	Coolwater	9
South Holston Reservoir	Washington County	Coolwater	11
Speights Run Lake	Suffolk City	Warmwater	14
Spring Hollow Reservoir	Roanoke County	Coolwater	11
Staunton Dam Lake	Augusta County	Warmwater	11
Stonehouse Creek Reservoir	Amherst County	Fertilized	9
Strasburg Reservoir	Shenandoah County	Warmwater	11
Stumpy Lake	Virginia Beach	Warmwater	14
Sugar Hollow Reservoir	Albemarle County	Coolwater	11
Swift Creek Reservoir	Chesterfield County	Warmwater	9
Switzer Lake	Rockingham County	Coldwater	11
Talbott Reservoir	Patrick County	Warmwater	11
Thrashers Creek Reservoir	Amherst County	Warmwater	9
Totier Creek Reservoir	Albemarle County	Warmwater	9
Townes Reservoir	Patrick County	Coolwater	11
Troublesome Creek Reservoir	Buckingham County	Warmwater	9
Waller Mill Reservoir	York County	Coolwater	9

Western Branch Reservoir	Suffolk City	Coolwater	14
Wise Reservoir	Wise County	Coolwater	11

*** The fishery type for Lake Whitehurst is warmwater rather than coolwater and the nutrient criteria will be changed to reflect this is the final version of the proposed amendments brought before the State Water Control Board for adoption.**

This resulted in the following breakdown:

Number of lakes/reservoirs	Percentage	Fishery Type
3	(3%)	VDGIF fertilized fishery
4	(4%)	cold water fishery
19	(16%)	cool water fishery
89	(77%)	warm water fishery

3.7 How Chl *a* and TP Values Will Be Used In Conjunction with Algicide Use

The AAC recommended using chlorophyll *a* as the primary nutrient criterion because of its close tie to biological effects while such a close relationship was not observed with total phosphorus. However, the Department's records indicate that 21 (18%) of these man-made lakes and reservoirs with ≥ 5 chlorophyll *a* observations have a known recent history of copper sulfate/algicide use. Therefore, the AAC developed total phosphorus criteria comparable to the proposed chlorophyll *a* concentrations that will also be applied when the application of algaecides is identified during the seven month sampling period of April 1 through October 31.

A more detailed discussion of this issue follows:

If DEQ staff document that algaecides are applied to the man-made lake or reservoir to control algal, the chlorophyll *a* criterion would not be an appropriate indicator of the degree of nutrient enrichment because the chlorophyll *a* test has a correction factor to ensure that only live algal cells are captured in the chlorophyll analysis. Therefore, where lakes are routinely treated with algaecides, the use of a chlorophyll *a* criterion would never indicate a problem when actually the algal problem was of the extent that it had to be controlled with algaecides. The algal cells would decay in the water column, release phosphorus and sink to the bottom. In a situation such as this, applying a total phosphorus criterion to total phosphorus levels in the lake would be a more appropriate indicator, especially since the state methodology analyzes unfiltered samples and thus picks up all sources of total phosphorus. In 2004 DEQ staff – at the request of the AAC – identified those impoundments on the 2002 significant lakes list where algaecides were known to be used. Staff were able to document that algaecides were used at 20 of the 100 lakes and reservoirs on the significant lakes list lists; this means that for approximately one-fifth (20%) of the significant lakes, reliance on a chlorophyll *a* criterion would not detect – or at the minimum - underestimate the nutrient problem in each of those lakes.

Algal treatment was discussed at June 8 advisory committee meeting and how chlorophyll would not be an accurate indicator of nutrient enrichment in PWS where algaecides were applied. The intent is to use both chlorophyll *a* and total phosphorus when algaecides are applied in any zone of the reservoir.

3.8 Background on AAC Analysis of Applicability of Fishery Criteria to Contact Recreation Uses

At the June 2005 meeting of the ad hoc advisory committee, Carl Zipper volunteered to do an analysis to see if the criteria developed by the AAC for fishery would also reflect protection for recreation uses or if contact recreation required more stringent criteria than for aquatic life protection.

Kurt Stephenson provided a PowerPoint discussion of this analysis at the July meeting whether the recreational fishing/aquatic life candidate criteria were consistent with user perceptions of acceptable

conditions for water contact recreation. He co-authored a summary of this analysis with Carl Zipper and Len Shabman: "Report of the Academic Advisory Committee to Virginia Department of Environmental Quality: Freshwater Nutrient Criteria Second Addendum to January 2005 Report. July 6, 2005." He said that secchi depth and total phosphorus values for the protection of fishery type were not as protective as user perception studies in other parts of the country had indicated as being needed for contact recreation uses, but one's expectations are dependent on what you are accustomed to. Chl-a levels of 25-35 ug/L were estimated to have water clarity in the 1.1 to 1.75 meter SD range. Water clarity above 2 meters generally was considered good for swimming, but highly variable. He said these studies provided no basis for concluding that chl-a levels approaching the limits of suitability for recreational fishing would yield water clarity levels that satisfied user perceptions for contact recreation.

However, VA DEQ has proposed using the numeric criteria developed for fishery type as an upper level for secondary contact recreational use such as fishing and boating and will request public comment on the appropriateness of this application of the criteria. Thus, we do not need to do a use determination to verify exceedence of the number to verify exceedence of the numeric criteria.

3.9 Rationale for Considering the Use of Different Indicators in Natural Lakes and Man-Made Lakes in VAC 25-260-310

The AAC recommended that natural lakes and constructed impoundments be considered separately. The rationale for this was that there is extensive scientific evidence that these systems respond differently to nutrient inputs (impoundments tend to have larger watersheds, lower retention times, more non-algal turbidity and require management as a result of having been constructed.) The AAC recommended separate criteria be developed for the two natural lakes in the State: Lake Drummond and Mountain.

- Mountain Lake and Lake Drummond are as different in water quality and morphometrically and hydrologically aspects from each other as they are from reservoirs;
- Mountain Lake is deep, clear, small watershed, stratified in summer (with good dissolved oxygen throughout) and oligotrophic, least disturbed;
- Lake Drummond, is shallow, unstratified, eutrophic, brown / black water continual turnover, low pH, good dissolved oxygen, limited access, balanced food web. Limited man-made impacts except through air deposition of mercury.

The watersheds for both of these natural lakes are protected and thus the distinctive (oligotrophic Mountain Lake and dystrophic Lake Drummond) but excellent water quality of both lakes has been maintained. Mountain Lake is located on lake privately owned by a hotel consortium, which has conservation easements and other measures to protect the lake which is a drawing card for their hotel property, plus there is a UVA/VA Tech biological station there; Lake Drummond is in the USFWS wildlife refuge in the Great Dismal Swamp.

3.10 Rationale for the Various Waters Repealed in Section 9 VAC 25-260-350, Designation of Nutrient Enriched Waters

Repeal of the four lakes (Rivanna, Chesdin, Smith Mountain Lake and Claytor Lake) listed.

On page 3 of the March 24, 2004 Virginia Development Plan for Nutrient Criteria there is the statement:

This effort will also involve an evaluation of the applicability of Virginia's current regulatory program (Nutrient Enriched Waters) for controlling nutrients in state surface waters by water body type (estuaries, lakes and reservoirs, rivers and streams). Appendices A through E describe Virginia's regulatory designations of these Nutrient Enriched Waters. Designations are based upon an evaluation of local water quality data for one or more indicators of nutrient enrichment (chlorophyll a, total phosphorus and dissolved oxygen fluctuations); the waters are protected from further enrichment by a companion regulation for control of total phosphorus from point sources. This evaluation will consider expansion of

the existing State approach to include designations of additional waters experiencing nutrient enriched problems and to address such issues as total nitrogen, watersheds and non-point sources.

If the concept of Nutrient Enriched Waters is not incorporated into the final approach selected by the State, a plan will have to be developed to transition from the existing regulatory Nutrient Enriched Waters listings to the new regulatory approach by sequentially deleting currently designated Nutrient Enriched Waters as the Commonwealth adopts nutrient criteria for those waters.

The decision was made to not incorporate the concept of Nutrient Enriched Waters in the final approach selected by the State. Those waters that would be regulated by the new Chesapeake Bay standards for the control of nutrient were proposed for deletion in the same rulemaking in which the new criteria were proposed. The approach proposed for deleting the four nutrient enriched waters that are impoundments is consistent with what was done for the Virginia portion of the Chesapeake Bay and the VA DEQ stated intent in their plan to transition from the Nutrient Enriched Waters to the new regulatory approach.

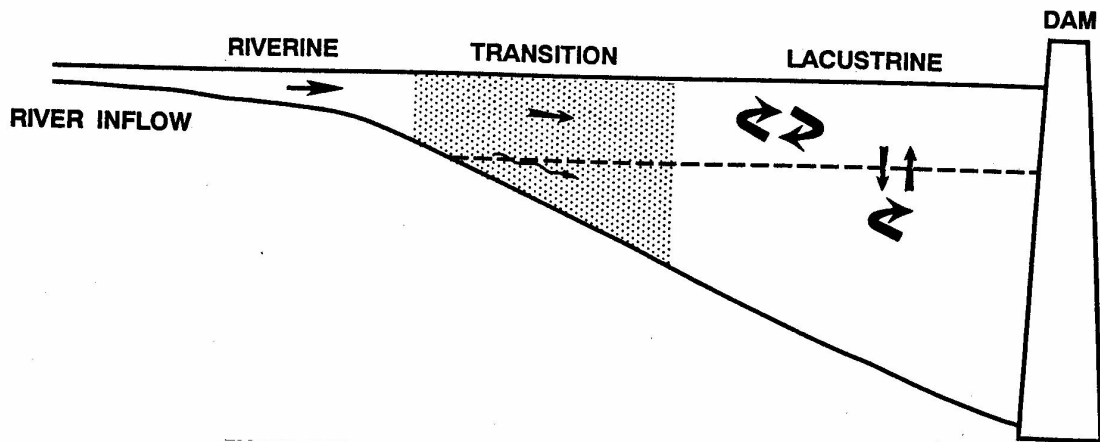
4.0 UPDATE TO TARGETED MONITORING GUIDANCE DOCUMENT

4.1 Current Monitoring Guidance

The current guidance on the agency monitoring of targeted lakes is the April 8, 2002 Department Guidance Memo No. 02-2004 "Targeted Lake and Reservoir Monitoring" which can be found at <http://www.deq.virginia.gov/waterguidance/pdf/022004.pdf>

4.2 Determination of Lacustrine Zone

The attached figure of the three lake zones (riverine, transition, and lacustrine) taken from Wetzel's third edition of **Limnology** illustrates the differences. The guidance document will include that drawing (see figure below), but the intended use is for assessment and monitoring purposes. The lacustrine zone is the lake-like portion of the impoundment. There may be arms of the reservoir that are considered lacustrine, that is, nonflowing lake-like conditions.

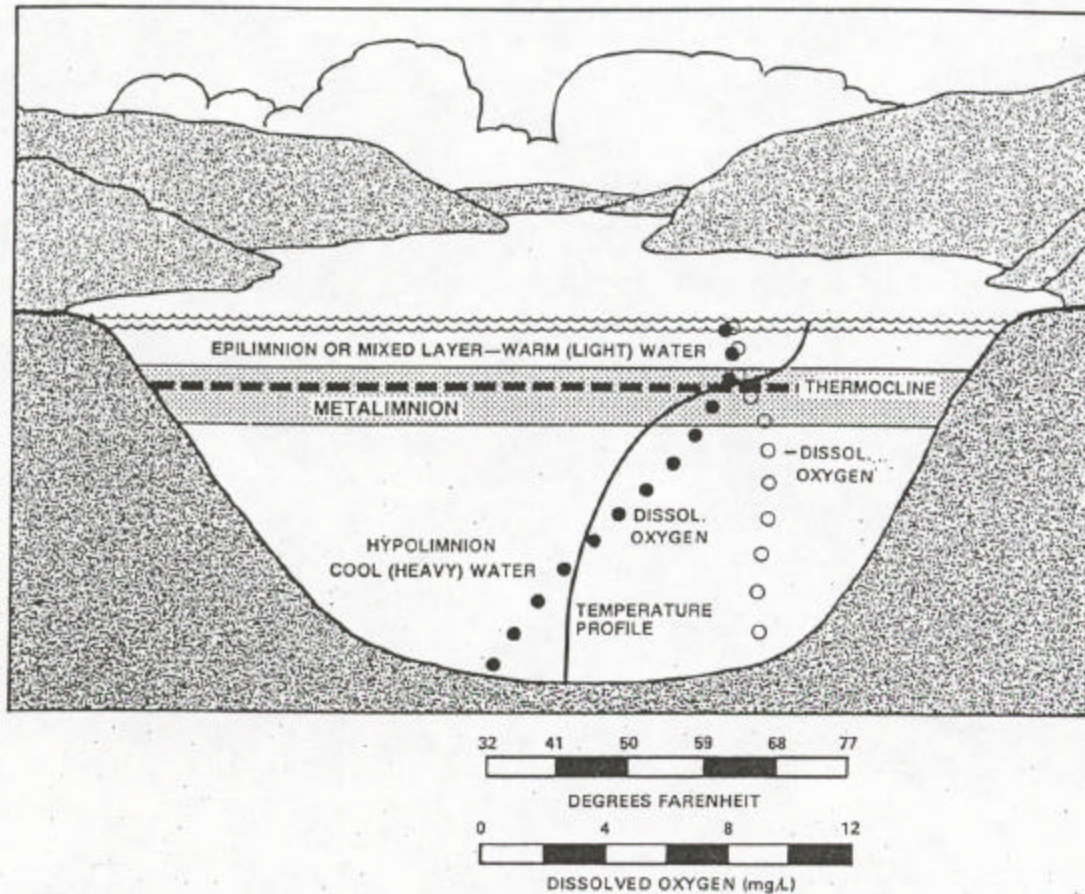


Generalized zones along longitudinal gradients in reservoirs.

4.3 Determination of Lake Stratification

When assessing monitoring data for compliance with the proposed dissolved oxygen application to only the epilimnion of a lake or reservoir listed in Section 187, it is necessary to determine where that break occurs. Please refer to the temperature/dissolved oxygen profile that follows. A lake is defined as stratified if the temperature profile meets the definition #3 below for a thermocline. If the thermocline cannot be delineated, that is, the temperature decrease does not reach 1°C or more for each meter of descent (or

equivalent to 0.55°F per foot), then it is not stratified. Shallow lakes (those typically less than 15 -20 feet) usually do not truly stratify.



A cross-sectional view of a thermally stratified lake in mid-summer. The water temperature profile (curved solid line) illustrates how rapidly the water temperature decreases in the metalimnion compared to the nearly uniform temperatures in the epilimnion and hypolimnion. The metalimnetic density gradient associated with this region of rapid temperature change provides a strong, effective barrier to water column mixing during the summer months. Open circles represent the dissolved oxygen (DO) profile in an unproductive (oligotrophic) lake: the DO concentration increases slightly in the hypolimnion because oxygen solubility is greater in colder water. Solid circles represent the DO profile in a productive (eutrophic) lake in which the rate of organic matter decomposition is sufficient to deplete the DO content of the hypolimnion.

THERMOCLINE—(1) The region in a thermally stratified body of water which separates warmer oxygen-rich surface water from cold oxygen-poor deep water and in which temperature decreases rapidly with depth. (2) A layer in a large body of water, such as a lake, that sharply separates regions differing in temperature, so that the temperature gradient across the layer is abrupt. (3) The intermediate summer or transition zone in lakes between the overlying epilimnion and the underlying hypolimnion, defined as that middle region of a thermally stratified lake or reservoir in which there is a rapid decrease in temperature with water depth. Typically, the temperature decrease reaches 1°C or more for each meter of descent (or equivalent to 0.55°F per foot).

4.4 Monitoring Period, Frequency and Station Location

The current monitoring frequency of once a month over a seven consecutive month period (April 1 – October 31) within one calendar year during the six year assessment cycle will continue as the AAC used historical DEQ data collected in this manner in developing the criteria. However, there are two situations where additional sampling should be done in a subsequent year:

- If sampled with one or more observations per month for less than 6 of the 7 sampling months, the lake or reservoir is placed in Category 3 (insufficient data) for assessment purposes and the next calendar year sampling is conducted during the missed months from the previous year so there are sufficient data for assessment.
- When the nutrient criteria are exceeded in a consecutive seven month period, the regional office will need to adjust the regional lake monitoring schedule to include second year of sampling for seven consecutive months within the six year assessment period in order to verify if there is an impairment.

Since the total phosphorus and chlorophyll a criteria apply only down to one meter and the current dissolved oxygen criteria only to the epilimnion during stratification in the 116 man-made lakes and reservoirs listed in Section 187, some of the monitoring data will not be used for assessment but may serve other regional needs. The temperature/dissolved oxygen profile at one meter depths is an essential element in the determination of stratification and should be continued.

The lake data will only be assessed for purposes of application of the chlorophyll a and total phosphorus criteria in the lacustrine (lake-like) portion of the impoundment, but that should not preclude regional sampling in the riverine and transition zones as many other parameters besides these two are normally collected and there are often concerns about bacterial or other parameter impairments that require sampling throughout the impoundment.

5.0 IMPLEMENTATION OF AMENDMENTS IN WATER QUALITY ASSESSMENTS IN 2008

5.1 Changes in Assessment Procedures

The timeline for the effective date of the proposed amendments is late 2005 or early 2006, so the new standards can be implemented for assessments in the next (2008) 305(b) assessment.

The AAC pooled the data from all locations and years for each lake for the monitoring season (April through October), for consistency with EPA guidance and because of the variability in numbers of observations among lakes. In accordance with the AAC recommendations to use in developing nutrient criteria, both the total phosphorus and chlorophyll a criteria were based on pooled measurements of all observations down to one meter over the 7 months. The only point where the AAC differed from the existing DEQ guidance is that they suggested pooling all observations within the lacustrine portion of a lake while the current DEQ assessment guidance talks about aggregating at a station. However, if we follow the approach the AAC used in developing the criteria and their instructions on how to evaluate the data, we would pool all data taken down to one meter in the lacustrine portion of the lake over all sampling observations. To strictly follow their approach, we would include in the pooled data all years in the assessment window.

The addition of new criteria (chlorophyll a and total phosphorus) to protect man-made lakes and reservoirs from nutrients and the application of the current dissolved oxygen criteria to only the epilimnion during times of stratification of the listed 116 impoundments in Section 187 will necessitate not only some changes in monitoring strategies but also how impoundments are accessed for these three criteria. Therefore, this preliminary guidance has been drafted to explain on how data collected from these waters will be assessed in 2008 by DEQ for nutrients and dissolved oxygen:

Man-made lakes and reservoirs listed in section 187 during the six year assessment period that meet the following monitoring criteria will be assessed for impairment for nutrients and dissolved oxygen:

- Sampled with one or more observations per month for least 6 of the 7 sampling months (April – October within the same calendar year), or
- If sampled with one or more observations per month for less than 6 of the 7 sampling months, the lake or reservoir is placed in Category 3 (insufficient data) and the next calendar year sampling is conducted during the missed months from the previous year so there are sufficient data for assessment.

Chlorophyll *a* or total phosphorus data are assessed for aquatic life (fishery) use and recreational use (secondary contact recreation such as fishing and boating) and dissolved oxygen is assessed for aquatic life use. (Bacterial data are used to assess primary contact use and observations regarding nuisance algal or plant growths or discolored water are assessed using the general standard as the basis.)

Assessments for chlorophyll *a* and/or total phosphorus will be conducted using the EPA recommended approach of considering each lake to be a sampling unit. In other words, all water monitoring observations for all months and all stations within the lacustrine portion collected between April and October and evenly distributed over that period at one meter or less are pooled. (This is the same approach that the AAC followed in assessing historical monitoring lake and reservoir data for developing the nutrient criteria.)

The forthcoming streams and rivers nutrient criteria would apply – once developed and adopted – to the riverine and transition portions of the impoundment.

The chlorophyll *a* criteria apply to man-made lakes and reservoirs listed in section 187 where algicides are not applied. The chlorophyll *a* criteria concentrations not to be exceeded are the 90th percentile of all water monitoring observations collected between April and October and evenly distributed over that period at one meter or less within the lacustrine portion of the man-made lake or reservoir.

The total phosphorus criteria also apply to man-made lakes and reservoirs listed in section 187 where algicides are applied. (The intent is to use both chlorophyll *a* and total phosphorus when algicides are applied in any zone of the reservoir.) The total phosphorus criteria concentrations not to be exceeded are the median of all water monitoring observations collected between April and October and evenly distributed over that period at one meter or less within the lacustrine portion of the man-made lake or reservoir.

A decision whether to base the assessment on chlorophyll *a* or total phosphorus for each lake will be based on regional office staff discussions with the lake owner regarding use of algicides during the monitoring period.

Assessment of dissolved oxygen will follow the current 2006 (link to VA DEQ web site is) guidance of assessing at 10% of pooled data of all samples within top or bottom layers during destratification and within the epilimnion during stratification.

No DEQ assessment has been done of the number of man-made lakes and reservoirs that would not meet these recently (2005) developed criteria under consideration for the proposal, but it is anticipated – based on the AAC evaluations of historical data in their January 2005 report – that some of the impoundments in Ecoregion 14 will not meet the chlorophyll *a* or total phosphorus criteria under consideration. The State of Tennessee has indicated an interest in adopting the Virginia nutrient criteria for lakes and reservoirs where the two states share the waters (such as South Holston Reservoir), so there could potentially be impairment implications for that state as well. It is also expected that some of the man-made lakes and reservoirs listed in the section 187 table will not meet the dissolved oxygen criteria during times of destratification.

Assessments of the two natural lakes in the special standards section will follow the guidelines above for chlorophyll *a* and total phosphorus but dissolved oxygen criteria will be assessed at 10% of all pooled data of all samples at all layers or a newer assessment approach if developed for the 2008 assessment.

The dissolved oxygen criteria are based on the appropriate criteria established for that class of waters in section 9 VAC 25-260-50. Dissolved oxygen information is used for assessment of aquatic life use.

5.2 Clarification of Assessment Period

An assessment period is the April 1 through October 31 monthly sampling period for one calendar year. That means within the six year (used to be five years) assessment period, the chlorophyll *a* criterion would have to be exceeded for two sampling years. Normally most lakes and reservoirs are only sampled for one year (7 month period) during the six year assessment cycle, but regional staff should do a second year within the six year window of sampling if the chlorophyll *a* criterion was exceeded during the first monitoring period of seven months. This change was made during a follow-up staff conference call with the chair of the AAC for freshwater nutrient criteria that we scheduled after talking with EPA about their comments. The AAC representative said that a second sampling period was needed to consider interannual variability as lake nutrient conditions can change throughout any given year and from year to year as a result of climatic variations and other factors. If the chlorophyll *a* criterion was exceeded for both seven month monitoring periods there was more assurance that the waterbody was truly impaired for nutrients. He said that Dr. John Ney believes that impairments should not be defined based on a single year of data, and - given year-to-year variability.

5.3 Minimum Sampling Data

The number of monitoring stations depends on the size and shape of the reservoir (see attached figure for examples). NALMS' current (2001) edition of "Managing Lakes and Reservoirs" is a good reference to use to determine location of monitoring stations. If it is a small lake, there might be only one station sampled per monthly visit. This monitoring station should be placed either near the dam in impoundments or in the deep center portion of lakes that are round in shape in the deepest part of the lake with collections monthly over the seven month period of April through October.

5.4 Impact of Proposed Standards on Existing Use of Trophic State Index (TSI) in Lakes

The assessment guidance for 2006 reflects the current method of assessing lakes which EPA has found to be an acceptable approach in lieu of regulatory criteria. The methodology was developed because VA DEQ did not have numerical criteria for nutrients in lakes and reservoirs (nor dissolved oxygen criteria specific for lakes) with the intention of using this approach until the public process was completed for these lake related criteria. Although the currently proposed amendments do not include a combined TP/DO TSI approach, one of the reports (web link: <http://www.deq.state.va.us/wqs/pdf/AACLAKEDO.pdf>) provided by the Academic Advisory Committee to DEQ on development of freshwater nutrient criteria responded to nine DEQ questions about dissolved oxygen criteria, including the appropriateness of using such an approach. The lakes and reservoir nutrient criteria are still at the rulemaking stage and public comment could result in revisions to the current proposal, so it would be premature to apply those criteria for the current assessment effort. The final version of these lake and reservoir nutrient criteria will not be in effect until late 2006 or early 2007. Therefore, the earliest possible use in water quality assessment of the final adopted version of the lake nutrient criteria would be during the 2008 assessment.

5.5 Use of Citizen Data

In order to use citizen data in assessments for nutrient impairments, the collector must provide documentation that the data meet QA/QC requirements for chlorophyll *a* and total phosphorus and that the location of the sampling was within the lacustrine (lake-like) portion of the reservoir. One member of the ad hoc advisory committee had a concern about coves being included in the lake assessment, as typically algal growth is greater in the coves. However, if there were multiple stations, pooling all the data – as intended by the AAC - might soften that effect.

5.6 Size of Calculation of Attainment/Non Attainment

Assessments for chlorophyll *a* and/or total phosphorus will be conducted using the EPA recommended approach of considering each lake to be a sampling unit. In other words, all water monitoring observations

for all months and all stations within the lacustrine portion collected between April and October and evenly distributed over that period at one meter or less are pooled. (This is the same approach that the AAC followed in assessing historical monitoring lake and reservoir data for developing the nutrient criteria.)

6.0 PERMITTING IMPLEMENTATION

6.1 Implementation

The new standards will be implemented upon each permit issuance after the effective date of the amendments.

6.2 Total Phosphorus Translator

Total phosphorus criteria apply in addition to chlorophyll *a* when algicides are used in the reservoir (see section 3.7 of this guidance). However, EPA Region 3 staff responsible for reviewing Virginia VPDES permits and water quality standards amendments has stated that the total phosphorus value assigned to the specific man-made lake or reservoir will also serve as the translator for a permit limit to meet the chlorophyll *a* criteria.

6.3 Mixing Zones

While mixing zone requirements in 9 VAC 25-260-20 subsection B.4 states that no mixing zones are allowed in lakes, mixing zone requirements 9 VAC 25-260-20 subsection B.1.a, B.2.a, B.5, B.6 are intended as requirements for aquatic life toxics criteria. Chlorophyll *a* and total phosphorus are not considered toxics criteria. Other conventional pollutants have been implemented using the basic requirements of the regulation (9 VAC 25-260-20 subsection B.9 (Waivers of mixing zone requirements), 9 VAC 25-260-10 (Designation of Uses) and 9 VAC 25-260-20 subsection A (General Criteria) using best professional judgment, which included mixing for conventional pollutants in lakes. Total phosphorus, as a direct permit limit for that criterion and as a translator for the chlorophyll *a* criterion will be implemented in the same fashion.

6.4 Impact on Permitted Discharges

There are no permitted discharges to the two natural lakes that are in protected watersheds, but there are 17 identified permitted discharges directly into the man-made lakes and reservoirs proposed in this amendment. When the lake or reservoir exceeds the chlorophyll *a* and/or total phosphorus criteria (as assessed using section 5.0 of this guidance) total phosphorus requirements may be imposed on discharges on a case by case basis via the TMDL that is established for that lake.

When permit limits via a TMDL have not yet been established or if the reservoir cannot be assessed as described in section 5.0 of this guidance or when the reservoir does not exceed the chlorophyll *a* and/or total phosphorus criteria several permitting actions may occur including:

Limits for total phosphorus may be deemed unnecessary for small volume discharges (< 50,000 GPD) or effluents not expected to contain total phosphorus;

Monitoring requirements for total phosphorus may be placed into the permit without a limit;

Limits for total phosphorus based on best engineering/professional judgments (including available dilution) may be placed into the permit.

6.5 Geographical Extent of Total Phosphorus Permit Limits for the 116 Impoundments Listed in Section 187

Only direct dischargers to the 116 man-made lakes and reservoirs in Section 187 are affected by these nutrient regulations; however, a future TMDL may discover upstream dischargers that contribute to the nutrient impairment of the lake that will require advanced waste treatment to remove nutrients.

6.6 Impact on Storm Water Retention Ponds

This should not impact the VWP program as the proposed amendments do not impose nutrient criteria on storm water retention ponds. The proposal only imposes nutrient criteria on the two natural lakes and 116 man-made lakes and reservoirs.

7.0 SUPPORTING DOCUMENTS FOR DEVELOPMENT AND ASSESSMENT OF THE CRITERIA

All VA DEQ and AAC referenced reports can be found at <http://www.deq.state.va.us/wqs/rule.html#NUT2>

From Ad Hoc Advisory Committee Members:

Clifton Bell, (VAMWA): Potential Survey Questions—Lake Use Attainment

Tom Bodkins (VMA): Nutrient Report Final FWQC, Nutrient report memo 040705, Nutrient Standards – App3, Nutrient Standards – App 4, Nutrient Standards – App 5

David Rosenthal (NALMS): Nutrient Criteria for Reservoirs Handouts distributed at the meeting and/or by e-mail prior to the meeting.

Slide show prepared by David Johnson (Ferrum College) and presented by Warren Smigo on “The Link Between TSI and DO: The Hypolimnetic DO Deficit.”

Slide show and handout prepared by Harold Marshall (Old Dominion University) on “Drummond.”

“Reservoir Use Attainment Evaluation Procedure” from Clifton Bell, VAMWA.

From DEQ:

Nutrient Criteria Development Plan for the Commonwealth of Virginia. March 24, 2004 Resubmission to EPA. Department of Environmental Quality Division. Office of Water Quality Programs.

Ad Hoc Advisory Committee meeting Summary. Lakes & Reservoirs Nutrient WQS. May 4, 2005.

NC DENR 2005 Response to VA DEQ Questions on NC Chlorophyll Standard Origin

Slide show on “Lake and Reservoir Nutrient Water Quality Standards Ad Hoc Advisory Committee meeting. June 8, 2005.

Ad Hoc Advisory Committee Meeting Summary. Lakes & Reservoirs Nutrient WQS. June 8, 2005.

Ad Hoc Advisory Committee Meeting Summary. Lakes & Reservoirs Nutrient WQS. July 7, 2005.

Slide show by Warren Smigo on “Mountain Lake. Recommendations for Water Quality Monitoring Criteria. Taken from the Recommendations of Dr. Bruce Parker to VADEQ”

Lake Nutrient Criteria Strawman: Amendments to 9 VAC 25-260-5 Definitions; 9 VAC 25-260-50 Numerical criteria for dissolved oxygen, pH, and maximum temperature; 9 VAC 25-260-187 Chlorophyll *a* Criteria for Man-made Lakes and Reservoirs; 9 VAC 25-260-310 Special Standards (Reserved for Mountain Lake and Lake Drummond).

From Academic Advisory Committee:

AAC Lake Oxygen Report – Final by Little, Singleton and Bryant

Monitoring (Mountain Lake) by Bruce Parker, VA Tech

Recreational User Perceptions of Lake/Reservoir Water Quality:
A Literature Synthesis by Kurt Stephenson

Report of the Academic Advisory Committee to Virginia Department of Environmental Quality:
Freshwater Nutrient Criteria. January 2005.

Report of the Academic Advisory Committee to Virginia Department of Environmental Quality:
Freshwater Nutrient Criteria. Addendum to January 2005 Report by Carl Zipper

Slide show by Carl Zipper on “Freshwater Nutrient Criteria for Virginia Lakes and Reservoirs: May 2005 addendum to AAC Report.”

Report of the Academic Advisory Committee to Virginia Department of Environmental Quality:
Freshwater Nutrient Criteria Second Addendum to January 2005 Report. July 6, 2005.

Slide show by Kurt Stephenson and Leonard Shabman on “Freshwater Nutrient Criteria for Virginia Lakes and Reservoirs: June 2005 Addendum to AAC Report.”